

Investigating

Communicating

Knowledge and understanding

Density Experiment

Learning outcomes in focus

Students should be able to:

NS4 Produce and select data (qualitatively/quantitatively), **critically analyse data** to identify patterns and relationships, **and justify conclusions**

PW1 Select and use appropriate measuring instruments

PW2 Identify and measure/calculate length, mass, time, temperature, area, volume, density and speed

Learning intentions

We are learning:

- how mass and volume affect density and to apply our knowledge of the relationship between these two factors to determine how the floatation of objects could be improved
- to design, plan and conduct an investigation to measure mass and volume
- to select the appropriate equipment for measuring the volume of different sized and shaped solids
- to calculate the density of both liquids and

solids

- to produce data on density and analyse it
- to identify patterns in relation to floatation
- to draw and justify conclusions on why a solid floats or sinks in a liquid

Teaching and Learning Context

This task was given to second year student. Prior learning included opportunities for designing planning and conducting investigations, explaining how fairness, safety and selection of suitable equipment was considered (NS3), analysing data to identify patterns and relationships, drawing and justifying conclusions (NS4), calculating mass and volume (PW2)

Task

Measure the volume (using $L \times W \times H$ or displacement of water, where applicable) and mass of various solids and liquids and calculate the corresponding densities. Using observations, on which objects sank in water and their equivalent densities, conclude why objects sink or float. Finally hypothesise whether objects will sink or float in liquids of different densities.

Success criteria:

I can:

- **SC1:** measure accurately the mass of regular & irregular solids using an electronic balance
- **SC2:** measure the volume of a regular shape like a cuboid using length x width x height
- **SC3:** measure the volume of the regular/irregular shaped objects using displacement of water
- **SC4:** give one advantage & disadvantage of displacement of water / $L \times W \times H$ for measuring volume
- **SC5:** evaluate and explain whether displacement of water or $L \times W \times H$ is more accurate for measuring volume of objects
- **SC6:** calculate the densities of the liquids and solids using the correct formula
- **SC7:** critically analyse data, make a justified conclusion as to why objects sink and float
- **SC8:** recommend methods of increasing or decreasing the density of a liquid/ solid

Density Experiment

Q1. Looking at the 8 solids provided which do you believe will sink in water and why?

The solids I think will sink are:

glass block: It is a very heavy solid

lemon:

lime:

Butter:

Butter: It is a very heavy solid

Q2.

Fill in the following table using the equipment provided

Solid/Liquid	Mass	Volume Method 1	Volume Method 2
Magnet	25.3.5	16	30
Soap Block	126.6	94	102
Butter	253.8	252	264
Oxo Cube	6.5	8	10
Wooden Block	67.9	157.32	158
Glass Block	358.5	136.8	138
Lemon	110.0		110
Lime	63		64
Water	358.4		94
7up	77.7		80
Oil	36.4		44

SC1:
Accurate representation of mass figures to one decimal place except for water where the mass of the graduated cylinder was never zeroed.

SC2:
Accurate representation of figures. All results correspond closely to actual figures.

SC3:
Accurate representation of figures. Magnet result inaccurate but given difficulty this is creditable.

Overall judgement:  Above expectation

Q3.

i) What are the advantages and disadvantages of Method 1 for measuring volume?

Adv ^{It is} → very accurate

Disadvantage → can only use it for square and regular objects.

ii) What are the advantages and disadvantages of Method 2 for measuring volume?

Advantages → Can use this for the objects that aren't square or rectangle.

Disadvantages → Not very accurate, because if an object floats to get the right volume you have to push it down with your fingers and this could cause a different volume

iii) Which method for measuring volume do you believe to be the most accurate?

method 1

iv) Explain the reason for your choice

In method 2 if an object floats, when you push it down your fingers could influence the volume

SC4:
 Lacks sufficient detail to explain the advantage, disadvantage given is incomplete.

SC4:
 Recognises that it can be used for irregular objects and identifies a recurrent problem.

SC5:
 Understands the term "accuracy" and gives a valid explanation for choice by rejecting Method 2.

Q4 Can you calculate the density of all the liquids and solids?

Liquid/ solid	Density (Mass ÷ Volume)
o Butter	$253.8 \div 252 = 1.007 \text{ g/cm}^3$
Soap	$126.6 \div 94 = 1.347 \text{ g/cm}^3$
Magnet	$253.5 \div 16.1 = 15.745$
o Oxo Cube	$6.5 \div 8 = 0.8125$
o Wooden Block	$67.9 \div 157.32 = 0.432$
Glass Block	$358.5 \div 136.9 = 2.619$
o Lemon	$110.6 \div 110 = 1.005$
Lime	$63 \div 64 = 0.984$
Water	$358.4 \div 94 = 3.813$
7up	$77.7 \div 80 = 0.971$
Oil	$36.4 \div 44 = 0.827$

SC6:
 Correct method for calculating density, selects correct units but most figures missing units. (Inaccuracies when measuring have resulted in incorrect results).

Q5 Look at the densities. Can you make any conclusion as to why an object sinks or floats in water?

If an object sinks it is because its
because the density of that object is
higher than the density of the water.
If it floats it means the objects density
is less than the water

SC7:
 Conclusion conflicts with the above results given the density of water was calculated 3.813g/cm³

Q6 Based on your conclusion above, can you predict which objects will float in the 7up?

The objects that will float in the
7up are wooden block,
and the oxo cube

SC7:
 Correct conclusion, justified by results above.

Q7 If you were to mix the three liquids together, what do you expect might happen?

the liquid with the most density
will ~~the~~ sink and the least density
will float.

SC7:
Correct statement but did not extend into the details of order of flotation. Demonstrates lack of understanding of the concept of density and flotation.

Q8. i) Is there any way that you could change the density of water?

(Hint: Why is it easier to float in the sea than in a swimming pool?)

you could change the density of water
by adding more of ~~any~~ things that dissolve
in water.

ii) Give an explanation for your answer to Q8 (Why will it change density?)

~~It~~ It will change the density because
As it dissolves it will ~~add~~ add ~~the~~
more density

SC8:
Doesn't recognise the change in mass of the liquid

Q9. Calculate the density of the play dough and describe the method you used?

The method I used was method 2.

1. First get the mass of the play dough as 106
2. Next, I put it in the overflow container and measured the volume. This was 78
3. So to get the density I divided the mass by volume and my answer was 1.3589741

Q10.

i) Will the play dough float or sink in water and give your reason?

It will sink because the playdough will absorb the moisture and become heavier.

ii) Is there a way to make the play dough float by itself?

Yes

No

iii) Explain your answer

There isn't a way to make the play dough float because instantly when you put the play dough in water it absorbs the moisture of the water and sinks.

SC7:

This is a viable hypothesis as play dough could very well have absorbed water.

SC8:

Given the answer to part i) if that was to be the case then the student is correct in her assumption that it eventually would sink.

Overall judgement:  Above expectation